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Rev. Rutherford, John.*

The Importance of Mining Records.

A LETTER

TO

P. S. HAMILTON, Esq.,

CHIEF COMMISSIONER OF MINES.

BY JOHN RUTHERFORD, M.E.,

INSPECTOR OF MINES. MEMBER OF THE NORTH OF ENGLAND INSTITUTE
OF MINING ENGINEERS.



HALIFAX, N. S.

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THE IMPORTANCE OF MINING RECORDS.

HALIFAX, MARCH 20, 1867.

SIR,—

In my report on the mining operations in the Province last year, I mentioned that at some of the collieries no record existed, either by survey or written description, of the first workings, and I alluded to the importance of a knowledge of their true position, and regretted the absence of some system by which such neglect on the part of the managers of mines might have been avoided.

I now desire to address you on the value of mining records, and to make a few suggestions as to the best means of realizing so important an acquisition of mining knowledge. The developement of the mineral resources of the Province has of late assumed so important an aspect, and mining operations are in consequence receiving such general attention, that the means by which a truthful and intelligible record of these operations may be preserved, cannot fail to be of great interest and value. Success is not the general result of mining adventures, indeed it is unfortunately too often the exception; nor is the want of it always attributable to the physical peculiarities of the mineral itself, but may happen from a deficiency of knowledge or error in judgment of the explorer. The rapid accumulation of wealth by the fortunate few invariably induces a rush of the many to the source whence it has been derived, and the first serious reverse often unnecessarily damps the ardour of the speculator; disgust takes the place of enthusiasm, and instead of being steadily worked in a skillful and judicious manner, the mine is closed, and mayhap remains unproductive for years. In the course of time the exhaustion of some beds or veins, or an increased consumption of their produce, induces the re-opening of the abandoned mines. How valuable then becomes the knowledge of former operations, and with what confidence every step is taken, nothing left to chance; but guided by those records which have

been so wisely and carefully preserved, the workings are not only made with safety, but also with a probability of success which they would not otherwise have. On the other hand, without such records, capital is uselessly expended, time wasted, and mayhap many valuable lives lost, by a sudden irruption of water or gas from the old workings. This is no fanciful picture; instances are not wanting in confirmation of its truthfulness, and I propose to relate the circumstances in connection with a few in illustration of the danger incurred by the neglect of some system such as I am now advocating.

The value of mining records is of a two-fold character, viz: their practical importance and their aid to scientific knowledge, or in other words, their importance with reference to their utility to the mining adventurer, and their value as a means of extending our geological knowledge. I propose to show how they may thus be beneficial; and I would remark that the time cannot but be considered fitting for drawing attention to the necessity of some system by which mining operations may not only be regulated, but registered, when we take into consideration the extent of these operations even at present. Until the last few years the number of coal mines in Nova Scotia was limited to those possessed by the General Mining Association, and the gold and other mines had no existence. Now there are upwards of 60 gold mines being actively prosecuted, 3000 tons of bar iron of a very superior quality have been produced during the last two years, 27 collieries have yielded in the same period 1,397,341 tons of coal, and several others are being rapidly brought into a position to augment this produce.

In a country like England, where mining has been practised for centuries, and the appliances of science are of comparatively recent adoption, we need not wonder that difficulties which are considered trivial in the present day should at one time have been thought to be insurmountable; and that mines were abandoned which have of late years been re-opened and profitably worked. Thus, Alston Moor, a large and valuable lead mining district, in the North of England, was considered to be exhausted upwards of 200 years ago, whereas for some time it has been a source of great wealth to the fortunate possessors of the mineral rights. Too generally no account, not even a sketch of the old workings, has been kept, and the only record of them is to be found in the statements handed down from sire to son with the ambiguity usual in such cases. It is not surprising that operations conducted under such circumstan-

ces should be attended with those casualties, the occurrence of which we have so frequently to lament. How some of these have happened I shall now proceed to narrate, and endeavour to show how best to avoid similar results. At Heaton colliery, near Newcastle upon Tyne, an inundation occurred on the 3rd day of May, 1815, by which 75 lives were lost. The workings had for some time been approaching some older workings to the rise, which were known to be full of water, but as there was *no authentic plan* a series of drifts was driven in advance, and bore-holes made in front and on each side out of them. Notwithstanding these precautions, however, the removal of the coal near a fault reduced the thickness to such an extent that it was unable to bear the pressure of water against it, and the sad catastrophe was the consequence. I give the preceding as in point of time it might be thought to be attributable to a want of that mining knowledge possessed in the present day. Numerous instances of a more recent date might be adduced to show that the occurrence of such casualties is less to be attributed to a want of care and skill than to defective plans.

An influx of water on the 15th of December, 1864, caused the death of eight persons at the Leeswood Main Colliery, near Mold, in North Wales. The water had accumulated in a goaf, *i. e.*, a space from which all the coal has been removed—which had been made only a short time before the accident. It was known to be full of water, but the lower workings were thought to be sufficiently protected by a portion of coal between two faults on the rise side of the new workings. The plan of the colliery was supposed to show all the workings, and had been made by a competent person, *but one portion only had been plotted from actual survey*, the remainder having been supplied from information given by a person who had formerly charge of the mine. Relying on the supposed thickness of coal between the workings and the goaf, no borings were kept in advance, and a holing was unexpectedly made with the unfortunate result I have stated.

On the 6th of April, 1859, the workings in the Neath Abbey Company's Collieries, in South Wales, were suddenly inundated by a rush of water from some old workings. It was known there were such workings, but in the words of the manager "*he did not exactly know their position.*" Care was taken to keep drifts in advance of the workings, and bore-holes in front and on each flank of the drifts. Notwithstanding this, however, one of the holes

proved a fault with a thickness of only $3\frac{1}{2}$ yards of coal from the face of the drift, which was too tender to resist the pressure, and the sad event occurred by which 26 lives were lost.

One of the most instructive examples of the necessity of extreme accuracy in laying down on plans every detail of the workings, is furnished by the fatal accident which occurred at the Clay Cross Colliery, in Derbyshire, on the 11th day of June, 1861. In this instance the position of the old workings was well known, as they had been carefully surveyed before they were abandoned, and filled with water. A barrier of coal from 40 to 50 yards in thickness was left between them and the workings to the dip, the position of the latter being also accurately delineated on the plan. No danger was apprehended under such circumstances, and but for the remissness of one man—in whose place the indication of water first appeared—in giving notice thereof in the proper quarter, probably no lives would have been lost. Suddenly, however, the water burst through the thin piece of coal which alone confined it, and in a very short time prevented all egress by the shafts, and thus 23 of the workmen were shut out from help for 22 days, and of course perished. On investigating the cause of this accident, it was found that a *single heading* had been driven from the old workings to the dip, probably to contain the water made in working the coal to the rise. This, it is supposed, must have been made *after the workings were surveyed*, and by some inadvertency on the part of the person at that time in charge, it had not been put on the plan.

It will not be out of place here to remark that even if bore-holes had been made in the usual way, they might not have prevented the accident, as the relative position of the two places was such that the front holes might have passed the face of the heading, and the flank one have been alongside of it, without holing in either case. But if the heading *had been shewn on the plan* the workings on the dip side would have been so arranged as to avoid it, and no risk have therefore been incurred.

Other instances need not, I think, be given in proof of the importance of some system by which mining operations may not only be accurately delineated, but also carefully preserved; and I proceed, therefore, to give a few practical details to be observed, in order that such records may be of that reliable character without which they will be valueless. And here I would again remark on the fitness of the time for carrying into effect these suggestions.

With the exception of the mines belonging to the General Mining Association, the workings are at present of limited extent, both in the coal and gold mines; and there is, therefore, less difficulty in having them faithfully laid down. Their position then is such as makes the primary object—a correct plan of the workings—easy of accomplishment. Whilst insisting on accuracy in this respect, I do not deem it necessary to prescribe any particular *modus operandi* so far as the survey is concerned. Assuming the survey to be correctly made, it is desirable that all plans should be so drawn that any one who has seen a mining plan may at once recognize the peculiarities of each mine. This can only be accomplished by the adoption of uniformity of detail. A similarity of scale and conventional signs is the chief means to this end. When dislocations of strata are represented on some plans by a simple faint line, on others by lines of different colors, and without regard to difference of size of throw,—perhaps wanting even that information, which should invariably be given,—and there is a similar irregular method of indicating the main roads and water levels, it will readily be imagined that some confusion must creep into any attempt to generalize from such plans the peculiar features of any particular coal field. That such a generalization is an important aid in selecting fresh openings for mining operations must, I think, be evident. Again, how important it is that any alteration in the seams or veins should be distinctly noted; they may in some districts of a mine become thicker or thinner, or be so divided by the gradual thickening of a band of stone in some part of the seam that only a portion can be worked, or in the case of a seam of moderate size both upper and lower division be too thin for profitable working. Nor is it unusual for one seam to be so separated as to form two and even three distinct seams several feet apart in another locality at no great distance from that in which the bands first appear. The difficulty of identification, it must be admitted, will be very much lessened by carefully noting and recording the change in each mine situated between the localities; and the value of a proof of this kind in sinking to other seams will, I think, be also apparent. Then, with respect to uniformity of scale: if to the discrepancies in delineating the peculiarities of the mine be added a variety of scales—some being 30 feet, some 40 feet, and others 66 feet to an inch—the difficulty of comparison, and, what is more important still, the liability to error, is very considerably increased.

Suppose, for instance, that the workings of a mine are approaching old ones which are probably full of water, and that the only record of their position is some rough plan on a different scale to that generally adopted, I do not assert that under such circumstances, with great care in taking the necessary measurements, a junction of the workings cannot be safely made, but that the risk of error in measurement is increased by the difference between the regular use of one scale and the occasional use only of the other.

In addition to the uniformity of scale and conventional signs, such alterations of the seams or veins, as I have alluded to, should be briefly described on the plan or on a book provided for that purpose, and in the case of abandonment of any mine, the fullest particulars should be obtained and recorded before it is closed.

Having thus endeavored to show the practical importance of mining records, I will now briefly point out how the intelligent manager of mines may contribute to our geological knowledge.

"Geology," it is remarked by Professor Phillips, "whether regarded as a history of the early physical revolutions of the earth, or as the science by which this history has been in some degree recovered, has really no other foundation than exact observation and careful induction."

Whilst those conditions of the mind necessary to a proper exercise of the latter process may not be generally possessed, there are few who have it not in their power to increase the basis of facts on which the superstructure is by such process to be reared. The identification of seams by a comparison of the over and underlying strata, the tracing of faults from one mine into another or through a district, the observance of the alterations of level, or dip and rise of seams, the structural character of the coal, the peculiarities of mineral veins, and of other circumstances worthy of note, may, in addition to their practical importance, materially assist in arriving at correct conclusions on many points respecting which there is still much indefiniteness.

In coal of a bituminous character there is generally a peculiar cleavage or facing, the distinctness or irregularity of which aids or impedes the working of it. According to the character of this cleavage the coal is broken off with greater or less ease, and its size when prepared for the market varies. In a practical point of view attention on the part of the managers cannot be too carefully given to this peculiarity, as it is found that in some cases larger pieces of

coal are produced by driving the working places at right angles to this line of cleavage and in others by working in the contrary direction. The course of these planes in different seams should be compared with respect to their similarity or difference. The strata of the coal measures also exhibit particular lines of fracture by which they are, as it were, divided into blocks. Careful observation of the direction in which these cleavages run, in conjunction with equally well noted particulars of the course, size, and direction of throw of dykes, may aid in determining the character of the movements by which these ruptures are supposed to have been effected. The composition and thickness of each bed of the strata should also be noted and measured, and especially should these be observed when shafts are sunk. An accurate section should be taken of the strata passed through in each pit, and that of the deepest on the colliery should be laid down on the plan.

Fossils, too, should receive attention, as their presence in particular strata has been found in some districts an invariable guide to the proximity of a seam of coal. The quality of the water, and the circumstances under which it appears in the mine, deserve attention for the indications it may give of the existence of particular minerals through which it has passed. Another subject worthy of observation is the internal temperature of mines. With the exception of those belonging to the General Mining Association, none of the collieries in the Province are sufficiently extensive to show much variation from the external temperature; but it is on this account a fitting time to commence such observations. As the workings spread to a greater length and depth, a record of the change in temperature will not be found uninteresting, and the time may come when such records may be of scientific value.

What I have already said respecting the accuracy and details of plans will, I think, render sufficiently evident their value as an aid to the knowledge of the peculiarities of any district. Sufficient, I hope, has now also been advanced in support of the object of this letter. There is so intimate a relationship between the aid to science furnished by such observations as I have suggested, and their practical value, that I am confident that no manager who desires to perform his duty efficiently will neglect to make them.

To bring the preceding remarks to a practical issue it remains to suggest a form of conventional signs for adoption, the scale on which the workings may be plotted, and to make a few observations

on the position of some seams with reference to their representation on a plan.

By conventional signs is meant a generally recognised mode of representing faults and other dislocations of the strata, horse roads, engine planes, water levels, the parts of the mines in which pillars have been removed and goafs formed, and other details which I need not enumerate. They will be more clearly understood on reference to the sketch of colliery workings attached to this than by any description of them. With respect to the scale on which the plans should be constructed, that adopted by the General Mining Association is a very suitable one, viz., two chains or 44 yards to an inch. Working plans may be made on a larger scale, but for general purposes this is to be preferred, as it is not only sufficiently distinct to admit of a niceness of delineation, but also for the representation of a large extent of workings on a moderate sized plan.

When two or more seams of coal are worked, a separate plan should be made of each, on which should be put every shaft and opening peculiar to each seam and to all; the points of connection of the seams, such as drifts from one to another, should also be shewn, and each seam in fact be represented as though it were the only one worked. In the case of seams in nearly a vertical position the workings must be shewn in a sectional form, and care should be taken to allow for the angle of declination, in order that they may be in their true position with respect to the crop. I must not omit to add, that in each Colliery it is very desirable that levels should be taken in the various districts and sections made thereof. These should be laid down on a separate sheet to be attached to the plan, or be kept in a book of a suitable size, in which also might be recorded all noteworthy remarks with reference to any of the peculiarities of the mine.

It has been my main object so far to direct attention to the importance of correct plans and mining records, and to suggest a uniformity in the mode of representing the workings, by which, together with a minuteness of detail and faithfulness of delineation their value may be secured. How their general utility may be made available, I will now endeavour to show. It is a fortunate circumstance for the realization of this object that, with a few exceptions, the minerals in the Province are held by the Crown. The same law regulates each holding; each mine owner is subject to the same conditions. These conditions sufficiently provide for

the establishment of such regulations as may from time to time be considered necessary. Copies of the plans may be made; their correctness, however, may be open to doubt. To remove this, I would respectfully suggest an arrangement with each mine owner for the employment of a competent surveyor, to be appointed by the Chief Commissioner of mines, by whom also should be fixed the rate of payment to be made by the owner or owners of the mines. As it is of equal if not of more importance to the latter that their operations should be truthfully represented, I do not anticipate any objection to this proposition.

Assuming it to be carried into effect, a copy of each plan should be made and deposited in the Commissioner's office or other place provided for that purpose, and future workings be from time to time added thereto, together with such memoranda as circumstances may suggest.

These plans should be open to any one for examination, with the right to copy—under certain regulations—such portions of them as may have relation either to projected or actual operations. There are other details of arrangement with reference to the construction and preservation of the plans so as to maintain their accuracy, that need not be here described. I have endeavoured to show the practical and scientific value and importance of some system by which the records of mining operations in this country may be collected and preserved, and thus, at the commencement of the development of its vast mineral resources, may be begun that aggregation of mining knowledge the want of which in England has been so frequently regretted. The explorer of a new field will thus be enabled to commence operations with that addition of knowledge to his own researches which the records of the nearest openings would afford him, and the future adventurer in abandoned districts, should there be such, be guided in his selection of the locality in which, according to the information thus to be obtained, he may with most reason look for success.

In conclusion, if the weight of stronger testimony than mine as to the importance of mining records be needed, I cannot quote any more earnest or eloquent advocate than the renowned Werner, who, after commenting on the value of properly constructed plans and carefully drawn up descriptions of mining districts, observes: "If our ancestors had left us such documents for two centuries past, or even for half a century, what advantage would it not have

been to us? From what doubts would it not relieve us? With what anxiety do we not turn over the leaves of ancient chronicles in search of information often very imperfect, obscure, and uncertain? With what pleasure do we not receive the least sketch or plan of some ancient mine? With what pains do we not rake up the old heaps of rubbish brought out of old excavations to discover pieces which may afford us some idea of the substances which were formerly worked out? Yet between these documents and those which we might obtain in the way pointed out in the preceding paragraphs there is as much difference as between night and day. Is it not an obligation, a duty, for us to collect and leave to future generations as much instruction and knowledge as possible on the labors carried on in our mines, whether it be in those that are still worked or in those which have been given up?"

I have the honor to be,

Sir,

Your obedient servant,

JOHN RUTHERFORD.

To P. S. HAMILTON, Esq.,

Chief Commissioner of Mines.

REFERENCE TO PLAN.

This ideal plan and section is intended to represent the principal features of a Colliery, and a mode of indicating them which might be generally adopted. The parts colored light brown are the horse roads or principal ways in the mine. Those colored blue are the water levels. Faults are indicated by red lines, varying in thickness according to the size of the throw; thus it will be seen in one place there is a fault with a throw of 6 inches gradually increasing to 10 feet. The line representing it is made thicker at the latter place accordingly.

Slip dykes are not generally very thick; their relative size in this respect may, however, be shown with sufficient accuracy even on the scale of this plan. The direction of these faults should be recorded in accordance with the course in which the working places in which they are met with are going; thus the 17 feet fault has been come to in the level driven from the shaft A to the north-east, and is therefore an up-throw in that direction. The 10 fathom dyke in the upper levels is also an up-throw to the north, though not in quite the same course; but as it has been met with in driving south-west, it is called a down-throw. This last named fault, it will be observed, has enabled the upper seam to be reached by a level drift which is shewn in the workings of the lower seam as far as the point of connection with the other seam. The plan of the workings in that seam should shew the same drift to an equal extent; or in other words, each plan should shew the full length of the drift from seam to seam. There is a staple or small shaft near the pit A to the upper seam, which should also be shewn on the plan of that seam. In the centre of the plan the pillars are supposed to be in course of removal behind the face of the whole workings; those shaded have been taken out, and represent a "goaf."

A band of fire clay is assumed to have made its appearance in the south west workings near the fault, and to be gradually thickening as they extend. Two sections are given to shew this alteration in

the seam. A section of the strata sunk through is also shewn; a record the value of which must, I think, be obvious. It is desirable for the ready identification of shafts—whether they have the workings in different seams connected with them or not—that a system of nomenclature should be adopted. Letters, numbers, names of persons, or indeed any peculiarity of position or circumstance will do for this purpose. The seams also, where they have not received a name, should be given one, indicative either of position or character; such name to be adopted wherever the same seam is worked.

One other point of importance requires to have attention drawn to it, viz., the meridian or north and south line. It will be observed that the magnetic meridian is marked on the plan, the variation from the true meridian being recorded. This should in all cases be carefully ascertained, and the date or at least the year when the plan is made, given.

The name of the colliery should of course be added to the title of the plan.

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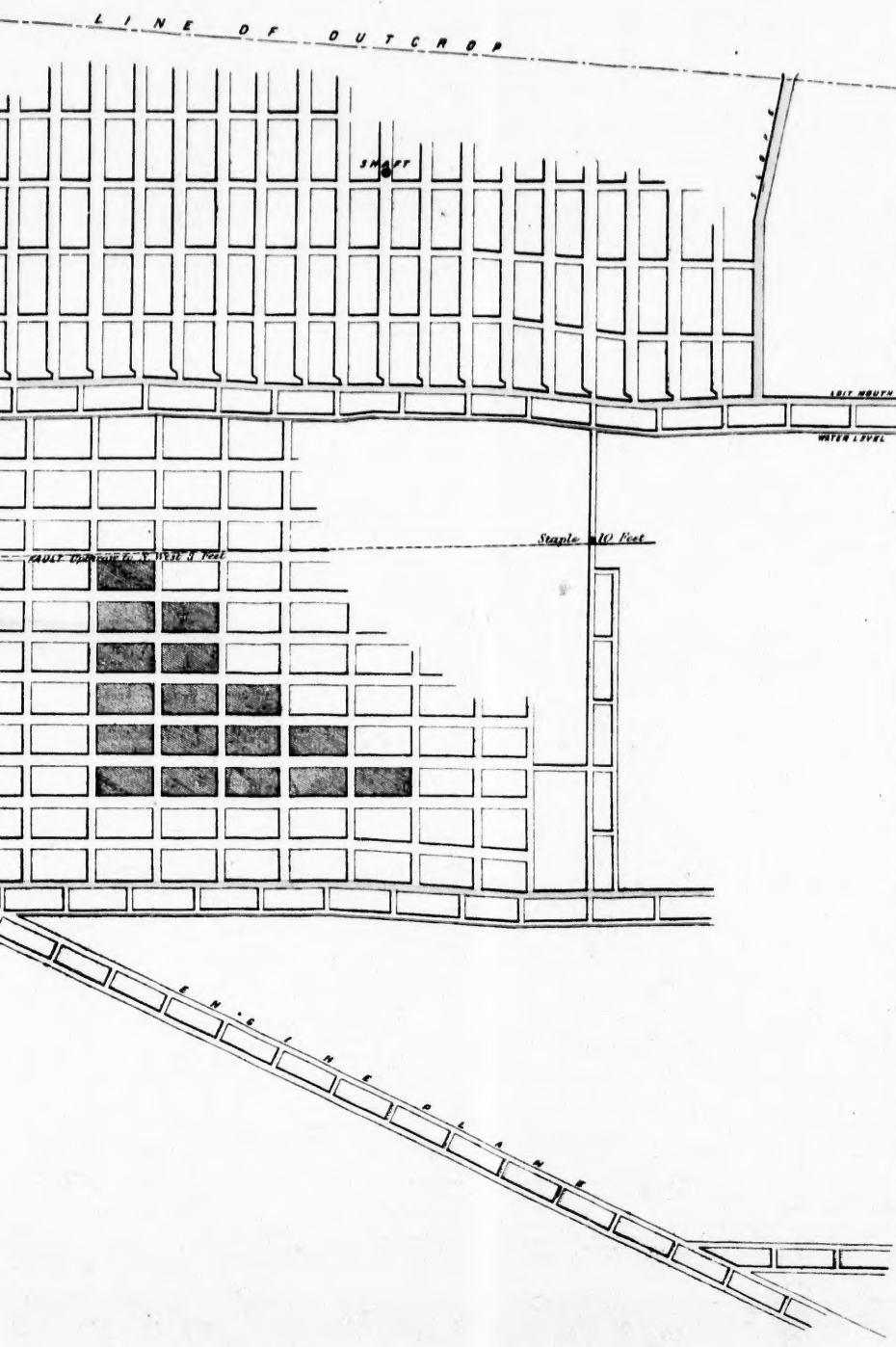
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SECTION OF STRATA sunk through in A.R.



	THICKNESS FT. IN.	DEPTH FATH.
Gravel	3	
Grey Sandstone	10	
Blue Sandstone	13	
Black Shale	2	
Grey Sandstone	7	
Fire Clay Ironstone	3	
Reddish Sandstone	17	
Grey shale with Ironstone Bells	6	
COAL Fire Clay	1	
Blue Sandstone	6	
Black Shale	3	
Grey Sandstone	16	
Black Shale with Ironstone Bells	7	
Blue Sandstone and Shale	9	
UPPER SEAM COAL Fire Clay COAL	1 6 2 7	
Fire Clay	4	
Dark Grey Sandstone	7	
COAL Fire Clay COAL	3 1 2	
Dark Grey Shale	14	
COAL Fire Clay	1 3	
Grey Sandstone	73	
Ironstone Bells	3	
Grey Sandstone	10	
LOWER SEAM COAL	6	

Geo. H. Rotherford